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Journal of the Society of Arts.

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FRIDAY, MARCH 20, 1868.

Announcements by the Council.

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Cantor Lectures.—Notice to Members.

Owing to unavoidable circumstances the last lecture of Dr. Crace Calvert's course will be delivered on TUESDAY, the 7th of April, instead of on Friday, the 3rd of April. A special ticket for this lecture is issued with the present *Journal.*

Artisans' Reports on the Paris Exhibition.

The Reports of the Artisans selected by the Council to visit the Paris Exhibition are now ready, and may be had of the Society's publishers, Messrs. Bell and Daldy, York-street, Covent-garden. One volume; demy 8vo., 732 pages, price 2s. 6d. in boards, or 3s. 6d. in cloth. The volume contains reports, by upwards of eighty artisans, upon the principal industries represented in the Exhibition, as well as special reports on the condition and habits of the French working classes.

Ordinary Meetings.

Wednesday evenings, at Eight o'Clock:—

March 25.—"On Horse as an Article of Food." By A. S. Bicknell, Esq. On this evening Sir John Lubbock, Bart., F.R.S., will preside.

April 1.—"How to make Railways remunerative to the Shareholders, beneficial to the Public, and profitable to the State." By Raphael Brandon, Esq.

April 8.—*Passion Week.* No Meeting.

April 15.—"On Liquid Fuel." By Benjamin H. Paul, Esq.

April 22.—"On the Cultivation of Beetroot, and its Manufacture into Sugar." By W. A. Gibbs, Esq.

Cantor Lectures.

The following is the syllabus of a course of four lectures "On Chloride of Sodium, or Common Salt, the Products obtained from it, and their Applications to Arts and Manufactures," now being delivered by Dr. F. Crace Calvert, F.R.S., as follows:—

Lecture II.—Friday, March 20.

The Bleaching Properties of Chlorine.—*Bleaching Powder*, its manufacture and application to the bleaching of calico, linen, and paper pulp; the manufacture of chloroform, &c. Illustrations.

Lecture III.—Friday, March 27.

Chlorine and its Compounds with Oxygen.—*Chlorate of Potash*—Its manufacture and remarkable properties. *Hydrochloric acid,* or spirit of salt—Its production and applications in Arts and Manufactures, viz., galvanizing of iron, sal ammoniac, chloride of tin, &c. Illustrations.

Lecture IV.—Tuesday, April 7.

The Conversion of Chloride of Sodium into Carbonate of Soda.—The decomposition of common salt into hydrochloric acid and *sulphate of soda,* Glauber's salt; the transformation of this compound into *soda ash, soda crystals,* and *bicarbonate of soda,* Ballard's process; and the important and recent discovery of the utilisation of soda waste, &c. Illustrations.

The lectures commence each evening at Eight o'clock, and are open to members, each of whom has the privilege of introducing two friends to each lecture.

Albert Medal.

The Council will proceed to consider the award of the Albert Medal at their first meeting in May next. This medal was instituted to reward "distinguished merit in Promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to His Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. W. Fothergill Cooke and Professor Charles Wheatstone, F.R.S., in recognition of their joint labours in establishing the first Electric Telegraph.

The Council invite Members of the Society to forward to the Secretary, before the 15th April, the names of such men of high distinction as they may think worthy of this honour.

Subscriptions.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

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Cantor Lectures.

The first lecture of Dr. Crace Calvert's course, "On Chloride of Sodium, or Common Salt, the

Products obtained from it, and their Applications to Art and Manufactures," was delivered on Friday evening, the 13th inst.

Fifteenth Ordinary Meeting.

Wednesday, March 18th, 1868; The Marquis of Clanricarde in the chair.

The following candidates were proposed for election as members of the Society:—

Bradford, Rev. William, 120, Cambridge-road, N.E.
Weston, Thomas, 115, Lower Thames-street, E.C.

The following candidates were balloted for, and duly elected members of the Society:—

Briggs, Thomas, Richmond, S.W.
Winsor, William Henry Benyon, 29, Kensington-gardens-square, W., and 38, Rathbone-place, W.

The Paper read was—

RAILWAYS AND THEIR MANAGEMENT.

By Robt. F. Fairlie, Esq., C.E.

The Society of Arts some years ago took into consideration several popular questions relating to railways, and although, as an engineer, I have other opportunities of drawing the attention of the profession (to which I have the honour to belong) to questions of a purely technical character, I desire to bring under discussion at this Society the general subject of railways and their management, in order that something may, if possible, be done towards bringing about a much-desired reformation.

At no period in the history of our railway system could the consideration of the various questions springing out of the subject of this paper have been so appropriately introduced as at the present, when it is remembered that a sum approaching in magnitude to the national debt is involved in their consideration. Probably no less than 20 per cent. of this enormous investment is at this moment wholly unproductive, and surely no question better deserves the serious consideration of our public men than that of devising some practical remedy for this lamentable condition of railway property, affecting as it does not merely those whose capital is directly invested, but the prosperity of the whole empire, and particularly so in the case of Ireland.

The question of the regeneration of Ireland has for a long period occupied and perplexed the ablest minds in the country. It is neither my desire nor my province to deal with its political condition, but it is impossible to ignore the necessity for dealing with the social and industrial welfare of the people. Everywhere railways have been found among the chief agents of civilisation and the real pacificators of discontent and disaffection. When you make a people wealthy and prosperous, political reforms become of secondary interest and will find their solution in due time. Ireland is essentially an agricultural country; and however much we may desire to see her advance in commercial and manufacturing progress, neither agricultural prosperity nor commercial success can be expected without an economical and efficient system of railway communication ramifying throughout every district. Much has been said, both in and out of Parliament, respecting the purchase of railways in Ireland. Royal commissions have inquired, select committees have reported, and statesmen of every party have devoted their best attention to this subject; but, after all, we are as far as ever from being agreed as to the policy of that course. I cannot, as a practical man, bring myself to recommend—although much may be said on both sides—an experiment of that speculative character, involving as it does the whole imperial question of Government purchase and management. I hold a decided opinion that it is our duty to assist and hasten the development of Irish resources in every possible manner, and I know of no better plan than that of extending railways throughout every part of the island. This we know cannot be done by private enterprise because of the unremunerative character of the existing lines, arising mainly from their great cost originally and from the diversity of control and management. There are extensive districts in Ireland urgently requiring railway communication, which ought to be constructed, alike for the public benefit and the advantage of the existing lines, always providing that the character of the work be good, and the cost moderate, such as to bring them within the scope of remuneration. But whence is to come the means of accomplishing this? I should say, by uniting to urge upon the Government the adoption towards Ireland in this respect of a policy analogous to that which has been so successfully applied to India, where a beneficent system of railway legislation has allayed the spirit of discontent and disloyalty in the growth of material wealth and individual well-being. An imperial guarantee of 3½ per cent.—which would probably not involve the State in a liability of more than about £100,000 per annum—would evoke from private sources alone sufficient capital to construct nearly one thousand miles of railway. This would add 50 per cent. of mileage, at a cost (say) of £3,000 per mile, which in my judgment is ample, having regard to the circumstances of the country. It is not to be denied that to continue the extravagant system of the past would be no advantage to Ireland.

I will undertake to say that such a guarantee from the Government would only for a comparatively short time remain a burden upon the State finances, provided that the outlay were judicious, and the management adapted to the actual requirements of each particular case.

Railway management in Ireland must surely have reached the height of absurdity when we find that something under 2,000 miles of road are governed by no less than between 30 and 40 different boards of direction. Omitting three or four of the principal lines, the average mileage to each board is not over 25 miles, and each board is independent of the others in every consideration of economy and management. As a natural consequence, the rates and fares charged are in many cases greatly in excess of what we are accustomed to on this side the water, seriously restricting the interchange of productions and the energies of the people. In Scotland about one-sixth of the entire mileage of the empire produces one-ninth of the gross revenue, while in Ireland about one-seventh of the whole mileage produces only one-twentieth of the gross receipts; besides, whilst there is one mile of railway in Scotland for every 1,460 persons, and one in England for every 2,257 persons, in Ireland there is only one mile for every 3,260 persons, so that Ireland is over 123 per cent. behind Scotland in this respect. I have the greatest possible objection to monopoly uncontrolled; but if unification of management and concentration of control do not involve monopoly, while experience has shown that they are indispensable to the success of railway enterprise, and that they act and react to the public advantage, I am therefore an advocate for concentration of management, because it secures and combines moderation in fares with profit to the shareholders.

It would be idle to point out what steam intercommunication has done for mankind in a thousand ways, and how important it is to devise means to increase its usefulness. I must be content with suggesting for consideration a few of the questions upon which I think railway reform and railway economy mainly depend.

It would be of no avail to refer to the waste of past expenditure in construction, except to say that the teachings of the past are the only safe guide to the policy of the future. As an engineer I am proud to confess that our English railways, apart from the wastefulness, constitute a magnificent monument to the constructive talent of the age. But utility and economy with due regard to safety must now be studied above all other considerations. The palatial stations of Charing-cross and Cannon-street I admire as much as any one from an architectural point of view (although there is no more convenient, elegant, but unpretending, or cheaper metropolitan station than that at London-bridge, which cannot have cost but a very small fraction of either of the former), but I want to earn dividends for the shareholders, and to give the greatest accommodation to the public at the lowest possible remunerative rate. I do not hesitate to assert that the cost of no provincial railway should exceed £10,000 per mile, including land, works, and plant, for a double line; but in many parts of England, and particularly in Ireland—where 60-mile velocities, for instance, are wholly out of the question—£3,000 per mile should amply suffice for subsidiary single lines, including rolling-stock, but exclusive of land, which I take for granted will freely be given for purposes so beneficial to the public, and advantageous to the landowners themselves. One remark I cannot help making here, with reference to the most gigantic and most improvident of all the metropolitan stations,—I mean that in course of erection for the Midland Railway, near King's-cross. This station, with its approaches, will cost a sum almost fabulous. I will only say that this outlay is a melancholy exhibition of railway extravagance, and that it goes far to explain the troubles into which railway enterprise has fallen. I believe this is the last erection of the kind that we are likely to see, and that the ambition of railway officials must, in the future, be confined to the prudent development of branch lines constructed upon a wholly new principle, which will render them a blessing instead of a reproach to our generation.

In making new railways, whether at home or in the colonies, the question of economical construction transcends all others in importance. I hold a strong opinion that the natural configuration of any country will, as a general rule, permit the working of railways upon what I shall here term the principle of surface construction, securing the public safety and convenience on the one hand, and a fair return for the capital invested on the other. Then, as to the question of maintenance,—it has never been properly treated, and it never will be honestly met so long as capital accounts remain open as a ready resource for every chairman out of which to bolster up dividends, and of every manager by which to maintain fictitious appearances. Had companies been kept face to face with only one source of supply, and that from revenue profits, they never could have fallen to their present depth of ruin and disaster. With an open credit, which we call capital, always at command, the opportunity, I may say the temptation, is ever present of debiting capital with all sorts of charges, which ought properly to have been placed against revenue. It is easy to conceive how, under such circumstances, directors of the highest honour and integrity have been led into errors which they now deplore; but their chief misfortune, in my opinion, has been the facility with which they have permitted themselves to be led away by officials with personal objects which do not appear to have harmonised with the true interests of the proprietary. All such charges as those for renewals of road, stock, and stations, ought undoubtedly to be charged to revenue without any reserve whatever; and I venture to think it would be well for a Society like this to devote some portion of its wide influence to making it clear beyond a question where the line should be drawn between capital and revenue. The closing of capital accounts is, I confess, no light matter in respect of existing companies. There can be no doubt that every new work of an original kind ought to be provided for by a special capital, if in itself of sufficient magnitude, and if not, in combination with other amounts, and in respect of any sudden or unlooked for expenditure of any considerable sums for way, stock, or works, I would have the amount carried to a suspense account, the redemption to be spread over a reasonable period, and to be made out of surplus annual revenue. If this or some analogous system be not speedily adopted, it requires no soothsayer to predict what must happen; "Coming events cast their shadows before," and with regret I say, that before many years have passed away there will be but few solvent railway companies left. It is not only the difficulty they are now experiencing in their finances, but every day is ageing the entire of their property, which must be renewed and kept alive by an outlay which will tax the solvency and ability of the best of them. Everything connected with a railway is subject to the usual law of decay, every item has a certain life, whether it be taken in itself or forming part of a whole, whether rails, bridges, stations, plant, or anything connected with them, and although chargeable to revenue, I am not aware of any case where a redemption fund has been provided for these inevitable occurrences. In future, I would imperatively close every capital account of a new line, with the authorisation of the Board of Trade, permitting the line to be opened for public traffic; this of course implies the necessary and sufficient amount of rolling stock and stations. All else, not accompanied by the creation of new mileage, ought rigidly to go to the debit of revenue.

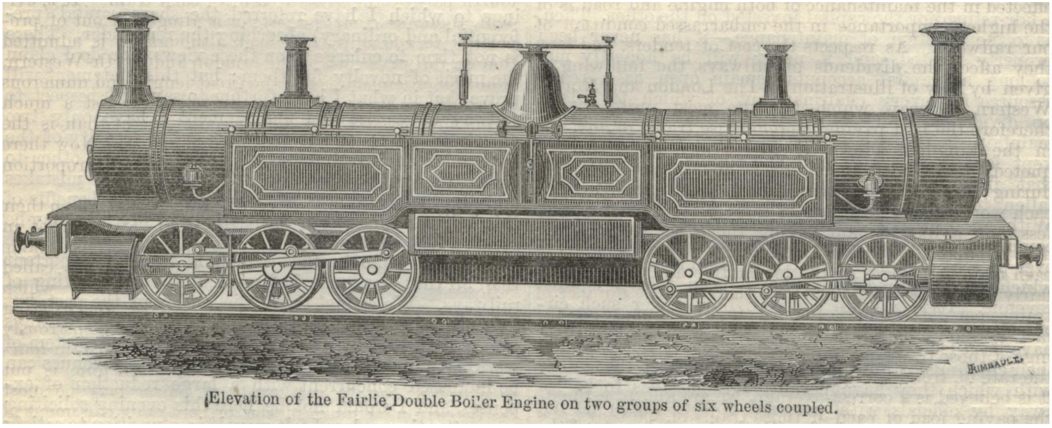
One word as to the mode which has recently been adopted of raising capital. The Brighton Company has on two occasions, issued ordinary stock at 55 per cent. discount, thus saddling the concern for ever after with £100 of liability for every £45 received. This is the worst possible mode of raising money, because it more than doubles every expense attending the line, including employés, stores, maintenance, and renewals. This, I fear, will be no solitary instance. A much more rational way of meeting necessities would be the adoption of the system pursued by foreign governments, of contracting loans redeemable half-yearly, by drawing out a fixed percentage to be set aside from surplus profits. Working expenses are the first natural charge upon gross revenue, then interest upon debenture stock, which stock ought to be made perpetual, like the national debt; then should follow the formation of a fund for the half-yearly drawings to which I have referred, the share capital (preferential and ordinary) absorbing the remainder. There is not time to enlarge upon these views, nor do I claim the merit of novelty for them; but this statement will prove that in what I have further to say with respect to railway enterprise and management I have only two objects in view; one is to increase the security of the companies as investments of capital, and the other to assure the public that, notwithstanding the mistakes and the extravagances of a generation, the benefits of this indispensable aid to civilisation and progress may be secured fully and widely.

We now come to that which is no less important than all that has gone before—I mean the working of railways. We cannot recall the outlay of the past, but I firmly believe that even the most unfortunate railways can be redeemed by a wise and well-arranged system of working. I shall endeavour to show that revenues can be increased concurrent with a large reduction of expenses, and I would not be here this evening soliciting your attention unless I felt myself in a position to satisfy you how this can be done.

As to the revenue, I do not believe that railway managers, as a rule, trouble themselves to know the return derived from each train run as compared with the expense of the same. I would have a debtor and creditor account with every train despatched; showing on the one side the whole of the expenses incidental to it, and on the other the total amount earned. The experience of the last 35 years provides us with very reliable figures of the cost of train mileage, in regard of every description of expenditure; and every train that would show a deficit in balancing the account should be unhesitatingly abandoned, excepting in such special cases as do not affect the general question.

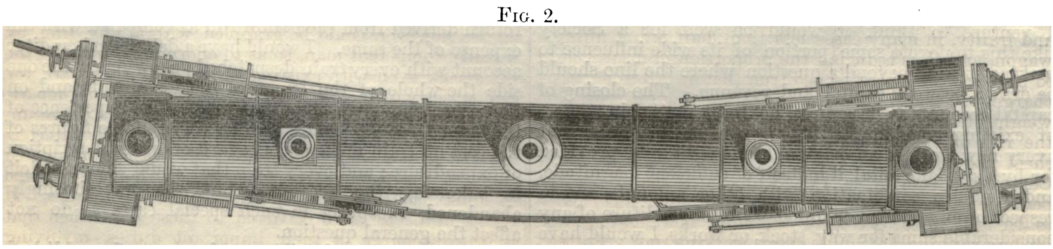
I illustrate this in detail by a reference to the published accounts of the London and North Western Railway Company, for the half-year ending June, 1866, which I have selected because it is comparatively low in the percentage of working expenses, and almost the best paying of all our railways. The gross earnings are at the rate of about 5s. per train per mile for passengers; and for merchandise 6s. 3¾d. To give shareholders the return to which they are justly entitled from this class of investment, I consider that the gross earnings necessary for this purpose ought not to be less than 7s. 6d. per mile for passenger trains at 20 miles speed, and increasing in amount to 10s. for 30 miles; 14s. for 40 miles; 20s. for 50 miles; and 30s. for 60 miles. It is absurd for companies to make so very little difference in their charge between high and low speeds as they do, knowing that whether in respect to the road, plant, or fuel, the cost increases in proportion to the velocity, and the charges should, therefore, be proportionate. I was much struck, when looking over the London and Brighton Railway accounts, to find that the gross earnings were under 4s. 10d. per train per mile, although, of my own knowledge, I am aware that many of their express trains, to and from Brighton, consist of some 20 carriages, each containing about 20 passengers, whose fares (allowing 25 per cent for season-ticket holders) must realise not less than about £3 per mile. It is clear, therefore, that the Brighton Company are running a large number of trains at a positive loss, else the average would not be so seriously reduced. If 4s. 10d. be a fair and remunerative rate (which it is not) no train should be run under that standard; and the maximum of £3 per train mile is as much beyond what is necessary as the minimum is below it; the medium between the two to be arrived at, by an abandonment of all unpaying trains, would produce to the company a handsome accession to its revenue on the one hand, and permit of a large reduction in the charges to the public on the other. I may be told that the cutting off of the unremunerative trains would be an invasion of the public convenience; but the best test of this is the patronage bestowed on particular trains, and the neglect of others which consequently do not pay. I am not forgetful that many of those unremunerative trains have been run, some from a spirit of rivalry, and some from a fear of competition; but rivalry must disappear in an effort to restore prosperity, and competition has found its level. Besides, the public are not so unreasonable as to expect that companies are to carry them without a proper return; the interests of both are identical, and neither is advantaged by a condition of things which has resulted in so much loss and misfortune. The expenditure part of the question is equally of vital importance, and I beg now to call attention to the amazing folly of railway engineers in overweighting the trains with that unnecessary and cumbersome appendage, the tender. The average gross weight of passenger trains may be stated at 70 tons; the average weight of a tender is over 25 per cent. of that, and invariably is over 200 per cent. in excess of the whole paying portion of the load carried. Now, when we know that not only is the tender costly, unnecessary, and cumbersome, but that the load of fuel and water which it conveys for supplying the engine can be made available for increasing the power and efficiency of the engine itself, I ask, what is to be thought of the persistency in continuing such an improvident system? There are at this moment working with great success on a Welsh railway engines with no tender, and where the fuel and water are in the highest degree conducive to the increase of power, economy, and safety. In their case the weight is distributed equally upon a large number of wheels, thus increasing the adhesion upon the rails, whilst the weight per wheel is proportionately reduced. (See Figs. 1, 2, and 3, the latter being section of Fig. 1

FIG. 1.



Elevation of the Fairlie Double Boiler Engine on two groups of six wheels coupled.

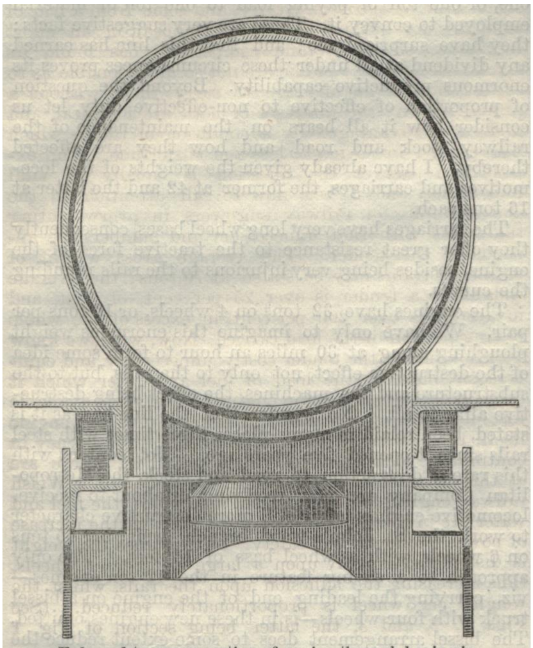
FIG. 2.



Plan showing the Fairlie Double Boiler Engine on a curve of two chains radius.

through bogie pin, to show the pivoting centre.) These advantages must at once be apparent, and, I believe, will lead to an entire revolution in our locomotive arrangements; besides, the enormous economy which is effected in the maintenance of both engine and road is of the highest importance in the embarrassed condition of our railways. As respects the cost of tenders, and how they affect the dividends of railways, the following is given by way of illustration:—The London and North-Western Railway, which has the most uniform, and therefore the best paying, merchandise traffic of any line in the kingdom shows by its balance-sheet, already quoted, 7,333,371 tons of goods and minerals carried during that half-year, being about 46,800 tons net for each working day; the tare of this tonnage would not be less than a like amount, giving the gross tonnage per day at about 93,600. The average gross weight of each train, exclusive of the locomotive and tender, may fairly be set down at 300 tons; therefore the number of trains per day would amount to 312, but from the fact, as stated in the balance-sheet, that the gross earnings of those trains per mile are under 6s. 4d., and taking the rate of freight at one penny per ton per mile, which it is believed is a correct average, we are able to estimate the paying load of each of those trains of 300 tons gross to be about seventy-six tons, or only 25 per cent., and thus we find that the number of trains per day must really be about 609, instead of 312. It is true that merchandize is composed of classes according to bulk and frailty, in many cases less than half a ton filling a wagon, and thus reducing the proportion of dead weight to paying load, but it is also true that in all such cases charges are made not only to pay for the full carrying weight of the wagon, but leaving ample margin to cover the risk of breakage in handling. The same balance-sheet shows that each net ton carried produces to the Company a sum of 4s. 7½d., which at a penny per ton per mile gives the average distance of each ton carried to be 55½ miles; we have therefore 609 engines and tenders running 55½ miles every working day. Following this reasoning, let us see how doing away with the tender affects the question. Taking the tender to equal the weight of two loaded wagons, giving a net result of ten tons, and there being 609 in motion every day, it follows that their equivalent in net paying load would be about 6,000 tons carried per day 55½ miles, which at the same average rate of one penny per ton per mile gives the amount earnable from this source at £1387 10s. per day, and for 313 working days—representing one year—£434,287 10s. We have been speaking of merchandize and mineral traffic only, but applying the same scrutiny to the figures of the passenger traffic (provided of course, there were passengers to be carried), and substituting carriages for tenders of an equivalent weight, we should arrive at an income of a somewhat similar amount, both amounting to £868,575 per annum net earnings, equal to a dividend of over 3 per cent. on the ordinary share capital. It is well known that the cost of maintenance of tenders is fully as much, if not more, than that of the carriages or wagons which are suggested for substitution.

Fig. 3.



Enlarged tranverse section of engine through bogie-pin.

The method of conducting passenger traffic yielding so little per train per mile, is of such importance, and the discrepancy between remunerative and unremunerative weights hauled, is so irrational and glaring, that it deserves to be considered a little more in detail. Still quoting from the London and North-Western Railway balance-sheet, it appears that the gross produce of 9,613,195 passengers is £1,280,507, or under 2s. 8d. per passenger. Taking the average rate for each at 1½d. per mile, this gives 21 miles as the distance travelled by each, whilst the gross earnings per mile of passenger trains are about 5s., which, at a like rate of 1½d. per mile, shows that the average number of passengers per train per mile is 40; allowing for a considerable amount of luggage to each passenger, this number could not be estimated at more than four tons. Now four tons is neither more nor less than about one-twelfth of the weight of the locomotive engine and tender (the tender alone being about five times this weight), and taking the passenger trains at say 50 tons, the paying load will bear not more than one-twenty-fourth part of the gross weight of each train. It is evident, therefore, that the paying is altogether out of proportion to the unpaying load, although it is admitted that on railways such as the London and North-Western, from the circumstances of the great length and numerous unprofitable branches, there must always exist a much larger proportion of dead to paying weight than is the case with lines with no such encumbrances. Now there is no reason whatever why the present disproportion should exist, or anything like it.

This is no new subject with men who have given their serious and unprejudiced attention to it. I find that in 1849, Professor Gordon, an engineer of considerable eminence, expressed, in a very able pamphlet called "Railway Economy," similar views to those which I have advanced. In page 4, he says—"The existing railway machinery will be found to be monstrously disproportionate to the useful effect produced in four-fifths of the number of times that the machine is put in action. And to this waste of power may be most justly attributed much of the present embarrassment of railway companies."

The judicious despatch of trains, and the proportion of paying to unpaying loads, are two of the most important subjects connected with railway management. These, however, could be grappled with at any time by a really competent man, so as to enormously increase the net result even with existing stock; but there are the difficulties which always surround independent departmental control, exhibiting on all occasions a strange unwillingness to adopt any change which shall interfere with their preconceived opinions, or occasion trouble or thought in departing from a system which one is tempted to think has its own personal peculiar advantages. It seems never to have occurred to these gentlemen that in the discharge of their important duties, involving every consideration they can bring to them, in the interest of their employers, what a close relation there is between the question of the dead weight necessary to the efficiency of the traffic and the dividends to those who have entrusted them with their important functions.

The Metropolitan Railway is, without exception, one of the greatest engineering triumphs of the age, being one of the cases where cost, it would seem, has been of secondary consideration; but, certainly, its management cannot be commended, and time will not permit of dealing with the general question. The magnitude of the traffic is evinced by the fact that during the half-year ending December 1867, nearly twelve millions of passengers were carried over the line by 348 trains on week-days and 212 on Sundays, averaging over 328 trains per day throughout the year. The distance run by each of these trains is understood to be 4¼ miles, consequently the train miles per day are over 1,396. By dividing the actual number of passengers, 11,916,924, carried for the half-year, by the number of days in the same period, we obtain 65,298 passengers carried per day, which, in 328 trains, is 198 passengers per train. This number of passengers per train for the entire distance run—say 4¼ miles—would give an average of less than 47 passengers per mile. This, however, is not the case, because the gross earnings per train mile being under 9s. 4d., the amount chargeable per passenger per mile would require to be about $2\frac{4}{10}$d. This would be above the average rate charged. It is, however, impossible to find out from the companies' balance-sheet what the real average is. To arrive at something like an average, I take 100 passengers, 50 single and 50 return journeys, from Moorgate-street to all stations, and divide these into 20 first-class, 30 second-class, and 50 third-class, which will give the average rate per passenger at 2·02d., and this divided into 9s. 4d. gives a little over 55 passengers per train per mile. The trains on this line are mostly composed of five carriages, weighing about 16 tons each, and one locomotive, weighing 42 tons, together 122 tons. Thus we have 122 tons of train weight to carry an average of 55 passengers, which at 14 to the ton is under 4 tons, being only one ton of paying load to 30 tons of dead weight. Some objection may be taken to this mode of dealing with figures. It will be said the average number of passengers given to each mile cannot be considered as the exact number travelling that distance. This is no doubt so, but it cannot materially affect the question, for if the whole average of 198 passengers travelled 1¼ mile, there would be none the remaining 3 miles; the only difference in the proportion of paying to unpaying load which could arise from this would be a slight increase of the former to the latter for 1¼ mile only, while for the 3 miles it would be wholly dead load. To prove the correctness of this calculation, we have only to assume what many might be disposed to imagine, that 198 passengers instead of 55 are carried per train per mile, the result would give 101,293,854 instead of nearly 24,000,000 now carried.

Nothing could be more appropriately said at this moment than the following quotation from Professor Gordon's pamphlet, written twenty years ago. At page 24 he says:—"These figures indicate the small portion of the mechanism of the railway system of transport that is actually brought into requisition even on the most frequented lines. Thousands, nay, millions of miles, are run by locomotives and carriages on the present system, whilst they are performing an amount of transport of passengers preposterously disproportioned to the power and capacity of the trains employed for effecting it."

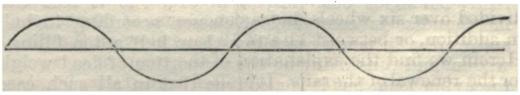
Contrast this condition of things on the Metropolitan Railway with our ordinary omnibus traffic. We find that the omnibus which has to travel over an infinitely worse road than any line, weighs somewhere about one ton, whilst it carries 28 passengers or two tons, thus giving a proportion of two tons of paying to one ton of unpaying load; but as we have included the weight of the horse, *i.e.*, the locomotive engine in the calculation on the metropolitan working, it is but fair to include the horses which haul the omnibus. Two horses with every equipment cannot weigh a ton, consequently at the very outside, the proportion is one to one, or one ton of paying load to one ton of material employed to convey it. These are very suggestive facts; they have surprised me; and that this line has earned any dividend at all under these circumstances proves its enormous productive capability. Beyond the question of proportion of effective to non-effective duty, let us consider how it all bears on the maintenance of the railway stock and road, and how they are affected thereby. I have already given the weights of the locomotives and carriages, the former at 42 and the latter at 16 tons each.

The carriages have very long wheel bases, consequently they offer great resistance to the tractive force of the engine, besides being very injurious to the rails rounding the curves.

The engines have 32 tons on 4 wheels, or 16 tons per pair. We have only to imagine this enormous weight ploughing along at 30 miles an hour to form some idea of the destructive effect, not only to the rails, but to the substructure and the machines, the effect being destructive alike to all. No wonder that the line has, as it is stated, been relaid in many places three times with steel rails since it opened five years ago. Not content with this rate of destruction to road and stock, the Metropolitan Company are now receiving, or about to receive, locomotive engines of a still more destructive character to work the St. John's-wood branch, weighing 45 tons on 6 wheels, with a wheel base of 14 feet. The only approach to a saving feature in the 42 ton engines—viz., carrying the leading end of the engine on a bissel truck with four wheels—is in these new engines omitted. The bissel arrangement does to some extent reduce the enormous friction of the engines on rounding the curves, notwithstanding which the grating and grinding noise of the wheels can be heard at a considerable distance. The spirit of rivalry between armour plates and guns is reproduced in steel rails and locomotive engines, with this difference, that the armour plates can be made to withstand the power of the heaviest guns, whilst steel rails cannot withstand the battering of these 45-ton steam hammer locomotive engines.

The destructive element of the ordinary type of locomotive is so vital, and affects the question of shareholders' dividends so much, that I would fain trespass on the time of the meeting to show how this results. The superstructure or principal weight of a locomotive engine borne on six wheels is supported on six points close to and inside each wheel. Between these supports and the wheel the carrying springs are placed. Now a very heavy engine with a great amount of overhang must, from the imperfections of the road, rock about a great deal, and the centre of gravity of the engine, instead of moving forward in a straight line, as it should do if the line and everything connected with it were perfect, forms a continuous line of curves and reverse curves on each side of the line of direction, as represented in Fig. 4.

Fig. 4.

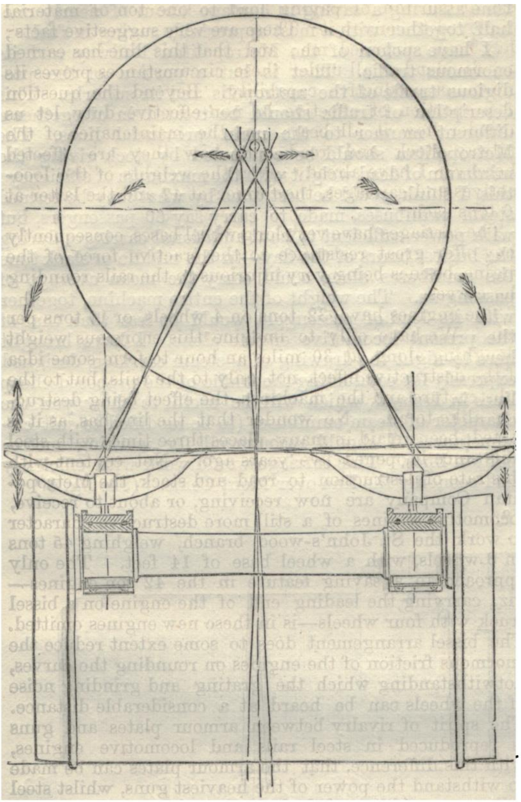


Showing the line traversed by the centre of gravity to each side of centre line of motion through the deflecting action of the springs.

This is caused at first by some defect or slight obstruction in the road, and afterwards kept up by the springs receiving and deflecting with the force of the up-and-down movement of the great body of weight resting on them, as shown in Fig. 5.

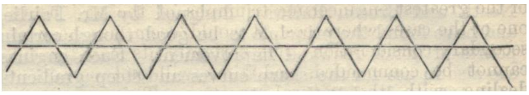
This action of the springs is caused by the oscillation of the centre of gravity to either side of the centre line of motion (see Fig. 5), and then easing themselves by flinging the weight from one to the other, either diagonal to, or at right angles with, the line of motion, and so repeated until the oscillations are gradually diminished; but it is found in practice that the oscillations never cease, for before one set is completely reduced another commences, keeping up a constant surging or soughing from side to side during the entire journey. The exact force of impact on the rail caused in this manner is represented by the amount of deflection of each spring beyond its normal condition. We shall be well within the mark by saying the destructive effect to the rail is over 60 per cent. more than the normal load on the wheels. Thus, in the case of the 45-ton Metropolitan engines, it is not simply this weight divided over six wheels, but a concussion of 60 per cent. in addition, or between 11 and 12 tons blow on the rails. Herein we find the explanation of the frequent necessity for the renewal of the rails. It is often argued that, because the additional load is received, taken up, and afterwards thrown off by each spring, the damaging effect on the rails is very little beyond that of the normal load, but I submit that this is not so. On the contrary, whatever extra force is thrown on a spring by momentum to flatten it beyond its normal condition, that extra force passes to the rail—not, however, as the blow of a hammer, as in that case the line of motion of the centre of gravity would be represented as in Fig. 6, but as a load graduated from its normal condition according to the velocity of the wheels and the time taken up by the springs in their action of deflection and return, better represented, perhaps, by a double inclined plane. (See Fig. 7.)

Fig. 5.



Showing the lateral movement of the centre of gravity to each side of the centre line of motion caused by the vertical action of the springs; showing also the deflecting action of the spring, and how it affects the centre of gravity; caused by an imperfect permanent way.

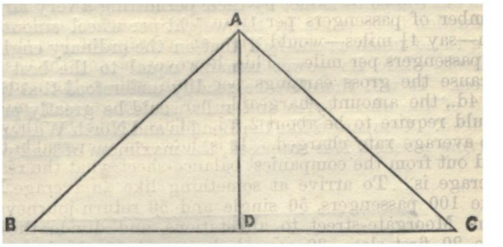
Fig. 6.



Showing the line that would be traversed by the centre of gravity to each side of the centre line of motion if there were no springs, each angle representing the blow of a hammer on the rails.

Fig. 7.

Double-inclined plane, showing how the concussion or blow is given to the rails beyond the normal or fixed load on the wheels; caused by oscillation.



B to A is a plane representing the deflection or downward action of the spring.

A to C is a plane representing the return of the spring to its normal position.

A to D represents the greatest deflection of spring, usually amounting to from 30 to 75 per cent. beyond the normal load of six tons on the wheel.

B to C distance traversed on periphery of wheel during time taken up by the spring in its action of deflexion and return to its normal position.

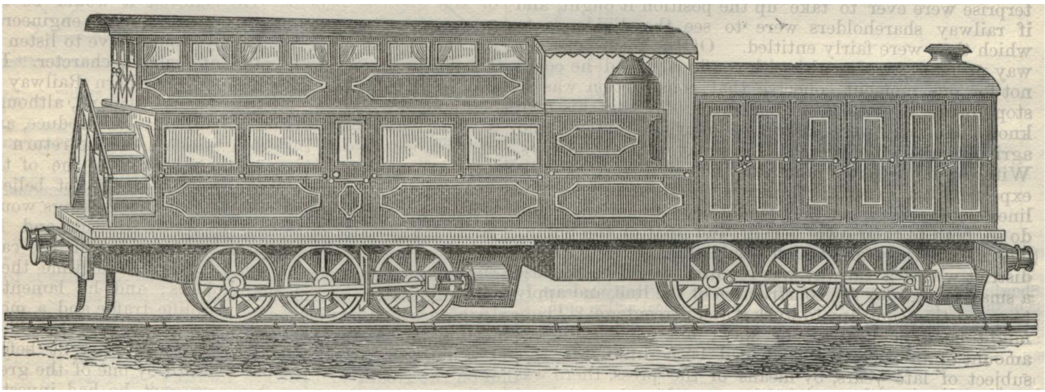
The best practical illustration I can offer to the meeting upon all these points of mechanical engineering is to invite attention to the models and drawings before it of an engine which has been specially designed to meet the objections we have just been discussing. The engine does not exist as a mere abstract idea, but is daily in operation on the Neath and Brecon Railway; and within the last few days one of them which has been working over two years, has undergone a severe test in the presence of several eminent engineers, who, in consequence have accorded it their warmest approval, several of whom I have the pleasure to see here this evening, and who may probably be disposed to describe their own experience.

The engines are remarkable for the almost total absence of oscillation, and the graceful ease with which they run round the very sharpest curves is matter of surprise to all who have ridden on them, the sense of safety experienced when on the engine is irresistible, and the motion is so pleasantly unlike that of the ordinary engines, that it has been described by Captain Tyler, of the Board of Trade, as giving the sensation of flying, and by others as that of sailing in smooth water. In corroboration of this it may not be considered out of place here to quote a passage from the report of Captain Tyler and Mr. Eboral, who have lately returned from an inspection of the Grand Trunk Railway of Canada. In page 44, after giving a full description of the locomotive engines in use on that line, the report says, "The class of engine best suited to the climate, and for the various circumstances of the case, would, I have no doubt, be an engine running on two bogie trucks, each provided with a pair of cylinders, and four-wheeled or six-wheeled, according to the work required—and without a tender. Such an engine would be peculiarly safe to travel over a winter road; would combine a minimum wear and tear to itself and the rails, with a maximum of adhesion, and would be the most effective and most economical that the company could employ. I had the opportunity some time ago of testing engines of this description on the Neath and Brecon Railway, designed by Mr. Fairlie, and have found the principle to be good, though certain points of detail required improvement. Such engines are also in use for the sharp curves and steep gradients of the Queensland Railway."

These engines have developed a relative power equal to two of the engines employed for hauling the goods trains on the London and North-Western Railway, whilst the destructive effect on the rails, road, and engine is greatly reduced. The employment of such engines would enable companies to double the carrying capacity of their lines without necessitating any additional outlay, and therefore they are especially valuable in the case of single lines. There are those who might consider it inexpedient to increase the present dimensions of goods trains, and in that case the engines would be too powerful, but the point is met by their permitting a very large reduction to be made in the weight per wheel amounting to so much as one-half that on the ordinary engine wheels, while its power remains equal to the best of them. It will therefore be readily understood that the life of the wheel tyres and rails would be greatly prolonged. Companies like the London and North Western, having reached, it is supposed, the maximum of load per train, have been driven to the costly expedient of triplicating their lines of rails for great distances. I venture to think that this immense outlay could have been avoided by the use of engines better adapted to the exigencies of an over-crowded traffic, whilst at the same time assuring a saving in haulage labour of nearly one-half, together with a most appreciable saving in fuel.

I have spoken of the Metropolitan Railway and its enormous traffic. That is but a portion of the prodigious traffic of the metropolis and its suburbs. This description of traffic should be treated in altogether a different manner to the main provincial lines. The Metropolitan should be conducted by stock giving the minimum of dead weight with the maximum of efficiency; this, I think, could be best done by what may be termed steam omnibuses, made to carry say 60 passengers, but with power sufficient to haul additional carriages during the busiest hours of the day—in the middle or slack time the omnibuses alone could carry the mean average of passengers. The weight of the entire machine, together with its load of passengers, would be less than that of the present locomotive engine alone. I have brought here to-night the drawing of a steam carriage, designed expressly for conducting the traffic of the proposed cheap lines in Ireland, which will be useful to show you the character of steam omnibuses (to be modified to suit circumstances) I should recommend for working metropolitan lines. This carriage would work with efficiency and economy the line over Mont Cenis. (See fig. 8.)

Fig. 8.



Fairlie's Locomotive Steam Carriage for working cheap mountain or agricultural lines.

Before closing this paper—already, I fear, too long—I desire to do justice to a gentleman, Mr. James Samuel, who, when engineer to the Eastern Counties Railway, successfully put in practice on that line very much the system of locomotive which I advocate now for metropolitan and branch lines. Mr. Samuel worked his invention for some time between London and Norwich, not only efficiently, but with very great economy. The economy was so striking as to be hard of belief. Why his system was discontinued I am not able to say; but of this we may be sure, that if the directors of that company had persevered with it, their shareholders would not to-day be mourning over an unproductive property. We should appreciate the man who in those early days was the first to remedy the monstrous disproportion between the paying and unpaying load of the trains, and it is satisfactory to be able to show you the drawings of Mr. Samuel's invention of that day.

I have thus endeavoured to bring before the Society a practical means of insuring the cheap construction and working of railways. To the noble Marquis in the chair, who is so constantly engaged in practical measures for the development of Irish prosperity, I flatter myself this must be a subject of peculiar interest. It will, I venture to think, create an impression in his mind that the Irish railway system may be completed with comparative ease, and that it cannot fail to prove remunerative. Ireland has no truer friend than the noble Marquis; and it would not be difficult to prove that as a statesman and a resident landlord he has devised practical measures for the substantial advancement of the country which have had the merit (something of a novelty) of commanding almost perfect unanimity. My plans may not command uniform assent, but at all events they are practicable. They may be opposed in some respects to established notions; but they effect the great object of giving all countries what they need in the way of intercourse at the cheapest possible expense. I submit them as in some degree a remedy for the errors of the past and of the present in financial mismanagement, and as a security against the evils of competition. With regard to Ireland, the noble Marquis will be the first to admit the advantages of substituting locomotive power for horse labour in bringing producers and consumers together. This is one of the main elements in agricultural progress. There is no reason in the world why the locomotive should not reach the remotest parts of Ireland. It depends upon surface lines worked by engines such as I have described. Sheep and cattle will increase in value; and the products of the field will never be deteriorated and wasted by distance from their markets. All Irish industries will be stimulated, and new careers opened for labour and capital, beneficial alike to those who engage in them and to the country.

DISCUSSION.

Mr. **Wm. Shelford** said, that having been for some years engaged in the construction of railways, and having also been concerned in their management, he had much pleasure in endorsing the views which had been put forward by the author of the paper, although he could not agree with him in all matters of detail. Mr. Fairlie drew a marked distinction between railway management and railway construction, and between capital and revenue—the capital being employed in the construction, and the revenue being earned and administered by the management. Upon that principle a line already constructed had nothing to do with capital, but should close the capital account as soon as possible; and, of course, the only chance of improving its position lay in improving and economising the revenue. He thought, with Mr. Fairlie, that there was a wide field open for any engineer who would set himself to work to reduce the weight upon the wheels of a locomotive, and by that means to reduce the permanent way account, particularly in the direction of repair and renewal, which in all railway accounts formed very large items. With regard to lines not yet constructed, they would be able to reduce both the capital as well as the revenue expenditure, and this must be done—particularly the first—if railway enterprise were ever to take up the position it ought, and if railway shareholders were to see the dividends to which they were fairly entitled. Of the future of railway property he thought with confidence, and he could not for one moment conceive that construction was to stop owing to past mismanagement. Within his own knowledge there were districts—suburban, mineral, and agricultural—which were still in great want of railways. With capital accounts practically closed, it was not to be expected that existing companies would undertake new lines or branches; but they would work them, and could do so, both to their own benefit and that of the public. The means, therefore, which would suggest itself in any district where a railway was required would be to raise a small capital for the construction of the line, and apply to an existing company to work it at a percentage. There might be difficulties in the way; but, considering the amount of information which had been diffused on this subject of late years, by means of the press, there was no reason to despair. As the great object was to keep the capital of a company small, he thought Mr. Fairlie had done great service in showing how such a large sum was required for the permanent way in consequence of the rails being knocked to pieces by the engine, and how a great deal of the first cost in both roads and bridges might be saved by improvements in this respect.

Mr. **Kintrea** said, that as no gentleman belonging to the engineering profession seemed inclined to offer any remarks of a technical character, he would say, as an investor in railways, that he felt very much obliged to the author of the paper for bringing this interesting subject under their notice. He could not consider it a matter of congratulation, that although the engineers of Great Britain considered themselves at the head of the profession, out of five hundred millions sterling invested in railways, a sum of from 120 to 150 millions had been entirely lost. It was to him a melancholy reflection that such had been the practical result of all their engineering talent. If Mr. Fairlie's paper were the means of bringing before the profession and the public a method by which they would be able to redeem the past, and to secure a profit on the capital which was invested in railway enterprise, the community would be much indebted to him. Not being a mechanical engineer, he (Mr. Kintrea) was not able to enter into the details of the construction, but it certainly seemed amazing that in a country like England, teeming with wealth, abounding in population, and that population, to a great extent, rich beyond precedent, and with a great propensity for travelling, railways should be uuprofitable and disadvantageous to those who had found the money for their construction. Anyone would have supposed that of all branches of industrial enterprise railways would be the most flourishing. From what he had seen of Mr. Fairlie's engine, he thought there was a great deal in his suggestions. Being desirous of learning whether that engine would be suitable to a district in Scotland, where money was of great value, he had availed himself of an opportunity of riding on one in South Wales. He found that it carried a load of 205 tons—the figures he had subsequently verified—up inclines varying from 1 in 50 to 1 in 70, and over curves of a character such as he had never seen elsewhere. He was very much astonished, and not less pleased, to find that the engine carried the load, not only with speed and safety, but also with a degree of pleasure to those who rode upon it, which might be called a new sensation. He hoped Mr. Fairlie would persevere, although he knew how difficult it was to get men in established positions to entertain new ideas. The experience of years in any particular system of railways made persons indifferent to any suggestion for improvement. It was the same with the paper-makers at one time; they declared that paper could not be made of anything but rags, at the very time when specimens were exhibited in the cloak-room of the House of Commons made from esparto grass; and now they had to admit that the introduction of this material had been of the greatest benefit. He believed it would be the same with locomotive manufacturers and engineers; the time would come when they would have to listen to Mr. Fairlie or other inventors of a similar charcter. He was a shareholder in the Great Northern Railway of Scotland, which did not earn a penny dividend, although it traversed a country rich in agricultural produce, and in the London and Brighton, which gave no return to its original shareholders, although it was one of the richest in passenger traffic; but he could not believe that under proper management such undertakings would be unprofitable. He had travelled abroad, and he found cheap fares, cleanliness, and comfort in the carriages on the Continent, while at the same time there were dividends to the shareholders; and he lamented that in England, with a more prolific traffic and a more commercial community, all this was reversed. They must not shut their eyes to what was brought before them because it was not put forward by one of the great railway engineers. For his own part, he had invested money on the faith of their scientific knowledge, and had found it a sadly losing speculation.

Mr. **C. F. T. Young** said the last speaker seemed to lay all the blame of railway misfortunes on engineers. He would ask whether it should not be divided amongst commercial men, lawyers, and engineers. Others might decide which class was most in fault, but certainly the whole blame ought not to fall on the engineers.

Mr. **S. Sidney** said he was not a shareholder in any railway, and, therefore, he could not speak with the same experience as Mr. Kintrea. He was not one of those political philosophers who seemed to fancy it was possible to obtain at once the advantages of private enterprise, of free competition, of a paternal despotism, and a close monopoly. He held the opinion that our railway system, with many defects, had given us more than any other country in the world. No doubt money had been wasted, mistakes had been made, fares in some cases were too high, and so they might go through a list of complaints; but this fact remained, that we had the railways for the accommodation of passengers and merchandise years and years before any other country had, and those who had followed in our track had been able to avoid our mistakes. It was, no doubt, a very nice thing for a shareholder in the Northern Railway of France to get a dividend of 17, 18, or 20 per cent., but it was not at all agreeable to passengers on that line to be packed as they were packed; nor was it pleasant to the merchants and manufacturers on that line, with some of the largest of whom he was well acquainted, to be treated as they were treated, and always would be treated in a country where there was a close monopoly and no public opinion. He made these remarks to show that he had no prejudice against English railways, but neither had he any prejudice in their favour. He believed we had paid the penalty of doing things quickly, of which we had had to some extent the advantage, and that it would be of the greatest benefit if public opinion were more turned to the matter. Many of the great engineers who had laid out the leading lines of the kingdom were gone, but they had left behind them a race of pupils who not unnaturally were prejudiced in favour of the bridge which carried them over, and who felt, as the Dutch professor in the "Vicar of Wakefield," who said he had lived all his life very comfortably without Greek, and he saw no reason for learning it. But that was no reason why the force of public opinion should not be brought to bear on railway reform, and no reform could be carried out without such pressure. The valuable paper they had heard called attention to two points—the first being the financial management of the lines. It was very unjust to put all the shortcomings to the account of engineers, for a great deal was occasioned by the financial management. The first thing required, in a financial reform, was a clear statement of the accounts, and he was glad to see that Government had introduced a Bill by which all railways would be obliged not only to furnish accounts, but to furnish them in one form, which he hoped would be an intelligible one. Accounts had been elevated into an abstruse science, and whereas formerly they were merely considered as a means of showing how much was received, and how much paid, accounts were now become a sort of Egyptian riddle, so that when one learned man had delivered his oracle, another learned man was required to explain it. There would be no efficient reform until that was done, which every one, with any knowledge of accounts, knew could be done, viz., presenting them in such a form that any shareholder, even the most stupid, could understand how much money had been spent, how much had been earned, and how much of what had been earned was properly divisible in the shape of dividend. If they would turn their attention to that, it would be much better than laying down any hard and fast rule as to closing capital accounts, which, after all, could not be done. For many years past, in the great railway companies, the money matters had been in a complete state of *hocus pocus*. The secretary might know something about them, and the engineer and the principal lawyer; and what they told the directors to do, they did. No doubt they had been extravagant, but that arose, in a great measure, from the whole thing being an unnecessary mystery. It was quite impossible for those who were not mechanics to express an opinion on the merits of the engine to which their attention had been called, but one thing he might say, they knew very well that the time had been when all railway engineers had acted, or had been prepared to act, on the principle that money was no object; but times were now altered, and those who had to develop the railways of the future, must turn their attention not in the direction of magnificence, endeavouring to have the biggest and the fastest engines, and the widest rails, but rather to the question of with how little expenditure of material they could work. In that way he thought Mr. Fairlie had rendered great service, but he did not think the leading engineers were so much to blame. He was not aware of any instance in which gentlemen brought up in a certain profession, which had proved very profitable to them, changed their ways and plans without outside pressure being brought to bear upon them. Mr. Fairlie's paper would be printed, and no doubt would be widely read, and Mr. Fairlie must be content with having thrown the stone into the water, feeling assured that others would follow him, and that the circles would gradually widen until a decided effect was produced. There could not be a doubt that there was still great room for the development of railways on economical principles, particularly in rural districts, and in a country like Ireland, which had been, in many ways, peculiarly unfortunate, and for which all seemed now willing to do something.

Mr. Botly thought they were very much indebted to the author of the paper; and certainly anything which could be done in the way of establishing railway communication in Ireland would be of great benefit to that country, and the present seemed a very favourable time for approaching the subject. He was not a very great holder of stock himself, and he thought the greater part of Mr. Kintrea's observations would have been more *apropos* at a railway meeting than on the present occasion. With respect to foreign railways, he had had considerable experience of them, and he must give the decided preference to the English. Engineers were blamed, and some blamed the Government, but they must bear in mind that at the first inception of railways no one dreamed that five hundred millions of capital would be invested in them, or no doubt the mode of action would have been different.

Mr. Blackie said those who were not engineers were not able to go into the details of what had been suggested, but it was beyond doubt that there had been a deal of mismanagement in railways in other departments as well as that of engineering. He travelled a great deal, and he must say he met with a great deal of carelessness in the subordinate departments of railway management. They must also remember that engineers had had but little time in which to produce great results. When the first engine started no one supposed they were going to run 50 miles an hour, particularly on the narrow guage.

The **Chairman** said if no other gentleman wished to address the meeting it would be his pleasing duty to move a vote of thanks to Mr. Fairlie, and he had no doubt of its being carried unanimously, whatever might be the opinions held as to the details of his paper. He confessed he was not in a position to go into the matter in detail, as it would require an able mechanical engineer to dissect, or even to understand, some parts of the proposed system, and others he was not sufficiently conversant with railway matters to dwell upon. Mr. Fairlie had spoken of him in terms which he did not deserve; but he might say this, that from the introduction of railways he had taken the greatest interest in their progress; and in reference to a remark of the last speaker, he might say that in 1830 he was at Rainhill, near Liverpool, on the occasion of the opening of a railway, and an eminent engineer—he believed it was George Stephenson—said he should not be satisfied until he saw an engine going sixty miles an hour. He thought Mr. Kintrea had been a little too hard upon the engineers, because, although in some respects he leaned to the same way of thinking, he thought too much blame had been attached both to engineers and directors, and to what might be called the management of railways generally, and that the real fault lay in what might be called the system on which railway construction had gone on. One gentleman had spoken of free competition; but there never had been free competition, and he did not think they ever could have free competition, in the wide application of the term, in such a matter as railways. If they were just to a company they must give it, to a certain extent, a monopoly. As far as he could judge of Mr. Fairlie's plan, it seemed a good one, and he had no doubt that cheap railways could be, ought to be, and would be made, but it would be very unjust to start a cheap line to run parallel and in competition with one already made at an enormous expense. They could not therefore have free competition, and what competition there had been had been of the most mischievous description. This had arisen from the mode in which permission to make railways had been granted, and from the system upon which companies had contended for districts. Companies had been ruining each other, not really to serve the public, but to get possession of a district, and compel the public to use their lines. The London and Brighton Railway had been mentioned, and he recollected that three years ago, when that Company, the South-Eastern, and the South-Western, were fighting as hard as they could, and projecting new lines in various directions, they were held up as models to show the good effects of free competion. But after a great deal of money had been wasted, several of the projected lines were withdrawn, and they all knew what had been the result in the case of the Brighton Company. As regards the faults which had been attributed to engineers and directors, he believed they arose in a great measure out of the system. They had been tempted to commit excesses by the difficulties thrown in the way of the formation of railways, and by the little control which had been exercised where it might have been, but where there had only been meddling interference. Shareholders had been induced to rely upon what were called the provisions of the standing orders committee, which were made one year and contradicted another, without any regular system; and instead of looking into affairs for themselves, they imagined that directors were so bound that they could not squander their money. So it went on, until the first effort was made, which was very good as far as it went, to introduce a better state of things by the establishment of what were known as Wharncliffe meetings. That was not sufficiently followed up, however, and shareholders still relied on the provisions of the standing orders, and on the Railway Clauses and Companies Clauses acts, which did not, and could not, regulate the conduct of directors. The consequence was that an immense quantity of money had been thrown away which might just as well have been spent in building a pyramid in a desert. Allusion had been made to the large buildings in Cannon-street and elsewhere; of course professional men took a pride in that sort of thing, and would run their customers, whether companies or private individuals, into much needless expense if they were not restrained. The main fault, he believed, lay with the system. What could be more absurd than for a committee to decide when people might begin to borrow, and at what rate. This they never could do effectually; the companies were obliged to apply for acts for this, that, and the other, crippling them in every possible way. When they talked about the great extent of their railways, they must recollect that if it had not been for the ingenuity of Mr. Lloyd, whose name would go down to posterity as having devised a method of driving a coach and six through an Act of Parliament, half the railways in the country would not have been made. If there had been a different system he believed engineers would have exercised themselves much more in devising plans for the cheap construction of railways, and how the expenses of working might be curtailed. He thought Mr. Fairlie had done good service in introducing his plan to the public, and he trusted it would be found that it could be safely acted upon, and that if he persevered he would meet with the success which he deserved. They could not go on making railways as expensively as they had done; but although there were so many lines, there were still many places where railway accommodation was required. Why should not every town have its railway, as every town would shortly have its telegraph? They could not everywhere have such a perfect railway as that of the London and North Western or Great Western, but they might have them made of a less expensive character, to meet the circumstances of the locality; and if engineers turned their attention to this, ways and means would soon be found. He must take some little exception to the way in which the working of the Irish railways had been spoken of, for with one or two exceptions he did not think anything like the same amount of money had been lost in that way as there had been in England. If that country was ever to progress and take the rank which, as the sister country to England she ought to take in the commercial world, there must be some large scheme for developing her resources. She had great natural resources, although her minerals were not equal to those of England. These resources were being gradually brought forward, but Ireland could not afford the immense losses which England had survived, and therefore the railways of that country undoubtedly required the attention of the Government; and he believed the public were quite willing that it should be given, and that they should be assisted in any way consistent with sound commercial principles. He would conclude by moving a vote of thanks to Mr. Fairlie.

The vote of thanks having been passed,

Mr. FAIRLIE, after thanking the meeting for the same, expressed his great disappointment at the way in which the paper had been discussed, as not one of the main points brought forward had been in any way touched. He had asked whether it was right that 20 tons of dead weight to one of paying load should be carried on the Metropolitan line; and he had hoped to hear this question discussed, because, if true, it was a most extraordinary state of things. Again, was it true that the London and North-Western could increase their dividends a certain rate of per centage by adopting a certain course, and if so, why was it not done at once? Why should the Brighton line run trains producing as high a rate per mile as £3, and yet only make the average 4s. 10d.? Those were the questions he had hoped would have been discussed. The question was how to improve the dividends, and bring back a large portion of the money which had been lost. He contended that the only way was to adopt a new system of construction and management altogether. He had not the opportunity of answering a single question, for not a challenge had been thrown out to him on any one point, nor had any one attempted to deny that what Mr. Samuel did 20 years ago on the Eastern Counties had resulted in a saving of expenditure to the extent of one-half. He had been at a great deal of trouble and research in examining the accounts of the different companies, and had laid the results before them in as clear a form as he could, and he thought the question deserved the attention of everyone.

NATIONAL MUSICAL EDUCATION.

Last year the heads of the musical profession addressed an appeal to the Government and the Royal Commissioners of the Exhibition of 1851, in favour of a Government School of Music and a National Opera. The memorial was as follows:—

"Understanding that the Government and the Royal Commissioners of the Art Exhibitions are being petitioned to contribute still further to the maintenance of the Institution called the Royal Academy of Music, we, the undersigned professional musicians, residing in England, realising the fact that the Royal Academy of Music has failed to promote the highest interests of musical art—that the Government grant has simply prolonged its existence, but not extended its usefulness; and feeling, moreover, assured that any further repetition of such attempt can only end in a similar failure, and prove equally discreditable to the country and wasteful of its funds—do hereby respectfully advise the establishment of a New School of Music, in which every advantage may be offered to musical students, to be presided over by competent professors, appointed by the State and responsible to it for the efficiency of the Institution. Connected with such an Academy, we would further advise, if possible, the establishment of an English National Opera, believing by such agencies a genuine and useful impulse might be given to the development of musical genius in this country, so as ultimately to redeem it from the disgrace of being the only European nation that fails to cultivate its own national music. Respectfully soliciting your consideration of our appeal,

"We remain, &c.,"

This memorial was signed by upwards of 250 persons, among whom were many of the most eminent of the musical profession.

TECHNICAL EDUCATION OF GIRLS IN FRANCE.

In France, as in England, the want of some means of enabling young women, respectably born and educated, but left by circumstances dependent or destitute, to earn their own livelihood, has long been felt. The only pursuit open to them—that of teaching—is one for which they are often not adapted either by inclination or education, though there are many occupations which they could with advantage embrace if they had been fitted for them by previous habit and training. With the object of providing for this want, the Vicomtesse D'Anglais (née Fernande de Jaubert), with the assistance of some sisters of a religious order, founded in 1854 the establishment of *Notre-Dame-des-Arts*, of which she herself was made the first superior. She first established herself in a small house in the Rue du Rocher, in Paris, but in 1863 removed to the mansion known as the Château de Madame Adélaide, in the park of Neuilly, which is situated in the midst of gardens and grounds of above four acres in extent.

The institution itself is a boarding school only, and is primarily intended for the benefit of the orphans of men of the learned professions, literary men, and artists; these compete for scholarships with which the school is endowed. Pupils are, however, admitted on payment, and are placed on exactly the same footing as the orphans, except that they do not compete for the scholarships. These pupils are the children of well-to-do parents, who are unable to make any certain provision for them, but by sending them to an educational establishment of this description they give them the means of becoming independent. The terms for paying pupils, including board and schooling, are 1,200 francs for French girls, and 2,400 francs for foreigners. Notwithstanding the high fees there are several foreigners, notably English, in the school.

During the year 1866-7 the number of inmates amounted to 130; the present year it is 140. The school is managed by eighteen ladies and sisters, including the attendants. Besides these there is a staff of fifteen assistants (*demoiselles auxiliares*), recruited from the old pupils of the school, who take part in the instruction.

The endowments for the scholarships are furnished by grants from the Ministry, from the General Council of the Department of the Seine, and from the Municipal Council of Paris. By a peculiar arrangement, a pupil can be admitted to all the benefits of the school, and the whole of her education is assured by one payment, fixed by tariff, on her entrance. This enables private or public societies, or individuals, to provide for the education of the daughters of *employés* who may have died in service without leaving sufficient means for their families.

In addition to the subjects of a general education, particular attention is paid in this school to the teaching of music and of decorative art; it is this element which renders the instruction technical in the real sense of the word. The subjects of decorative art which are practically taught are:—Designing patterns for tapestry; church ornaments and jewellery; painting on porcelain, china, and enamel; painting on glass, and church windows; painting in oil and water-colour, crayon drawing, and painting on ivory; lithography; engraving on wood and steel; embroidery in general, and especially of church vestments; artificial flower making. A permanent exhibition of the results of the instruction in decorative art is established in the institution of Notre-Dame-des-Arts, and is frequently visited by both French and foreign artists and manufacturers.

To raise the standard of education at this institution as high as possible, a course of superior practical study has been formed, which extends over four years, and the fee for which is 1,500 francs. The institution trusts to the sale of the productions of the pupils to defray the expenses, which of course considerably exceed the fee. Pupils who may have received their general education at other establishments are admitted to this superior course, after having passed an examination on the same terms as the girls from the lower school.

In order to maintain its connection with the old pupils, and to enable them, should they wish it, to turn their acquirements to account, the institution is about to establish a co-operative society of Notre-Dame-des-Arts for the production and sale of articles of embroidery, drawings, paintings, engravings, &c. As a first step towards the realisation of this project, a monthly journal, called the *Album de Notre-Dame-des-Arts*, has been published since the 1st December, 1867. This contains musical compositions, lithographic drawings, wood engravings, &c., and is intended to form an educational periodical, bringing together teachers, present and old pupils of the school, and their families.

THE COMPARATIVE MORTALITY OF EUROPEAN CAPITALS.

The following is from the *British Medical Journal*:—

In a recently-published work by Dr. Vacher, of Paris, "On the Comparative Mortality from Ordinary Diseases in London, Paris, and the chief Continental Cities during the year 1866," a great number of interesting facts are given, which bear upon hygienic questions, and also upon matters of general interest. Paris presents the lowest death-rate, the proportion of deaths to population being 1 to 43·4, London stands second in the list, the deaths being 1 to 41. The rate is highest in Berlin, where the numbers are one to 30. In Paris, London, Vienna, and Stockholm, one-fourth of the whole number of deaths is put down to diseases of the respiratory organs. In all the chief cities, more deaths are due to phthisis than to any other single cause; one death out of four in Vienna, one out of eight in London, and one out of 16·8 in Stockholm, are the proportions given by Dr. Vacher, who states that tubercular disease of the lungs becomes less prevalent as the northern parts of Europe are approached; and alludes to a fact indicated by Dr. Leared, of the Great Northern Hospital, that in Iceland this disease is quite unknown, and not expressed by any word in the language. Those who have been moved by the taunts of French satirists on the depressing influence of the fogs and cheerless climate of Albion, will probably be startled to learn that, whilst the suicides in London amounted, in 1868, to 258, in Paris, where this crime is alarmingly on the increase, they were no less than 847; 717 of which were in males, 125 in females, and five in children. In London the number of murders was 138; in Paris, 13. Some curious details are also given concerning still-born children. In Paris, the number in one year reached to 4,356: this excessive amount, however, is partly explained by the fact that, according to the French law, all infants who do not survive longer than three days are considered as *mort-nés*, and also non viable fœtuses, and even abortions in which the sex cannot be distinguished from insufficient development of the organs. In Paris, the proportion of still-born boys to girls is as 42 to 34, whilst in children who live it is as 35 boys to 34 girls. This difference, Dr. Vacher holds, is only partly due to the difficulties of parturition caused by the larger size of the cranium in boys, and is owing in some measure to some obscure cause which still remains for embryologists to determine. The proportions of deaths in hospitals to those at the individuals' homes are, in Paris, one to three; in London, one to five; in Vienna, one to 2·1; in Brussels, one to two.

Fine Arts.

Annual Exhibition of Works of Living Artists in Paris.—The Paris *Salon* opens as usual on the 1st of May, and will remain open until the 20th of June, A further modification in the method of electing the jury has been adopted; as before, one-third of the jurors are to be named by the authorities, and the remainder by the artists themselves; but the basis of the art suffrage has been very materially extended. Previously only those artists had votes who had received a medal of the first class, or an honorary decoration; now, every artist who sends in one or more works for the coming exhibition, and who has had even one work received at any former exhibition, with the single exception of that of the revolutionary year, 1848, when there was no previous examination by a jury, has a right to vote for the jury; and, in addition to this, the franchise is extended to young artists who have won the Grand Prize of Rome at the Ecole des Beaux Arts. This is a very near approach to universal suffrage, and is hailed with much interest by the body of artists. The preliminary lists of names for election are already circulated, and they include those of the best artists of the day, with the exception of the Professors of the School, and some others who, it is well known, will be included in the official list. No provision has been made for the voting of those artists who reside at a distance from Paris, but we believe we may assert that the omission will be supplied in a day or two, and that the artists in the provinces or elsewhere will be enabled to send up their balloting lists by the post, or through their agents in Paris. The jury, as before, will act in sections, and it is necessary for the reception or rejection of the works sent in that two-thirds of the members of a section should be present. A majority is required for the admission of a work, but in case of the numbers of votes being equal, the work is allowed to pass. The right of admission of their works without examination is retained by the members of the Institute, by those artists who have been decorated, have received a medal at a former exhibition, or won the Grand Prix de Rome.

Sale of the Works of the Late Théodore Rousseau.—The sale of the pictures, sketches, studies, drawings, and water colour works of the late famous landscape painter Rousseau, is announced to take place on the 20th of April, at the Hôtel Drouot, Paris.

A Relic from Jerusalem.—The architect employed in the reconstruction of the Church of the Holy Sepulchre is having moulds taken from the tomb of Philippe d'Aubigny, recently discovered, for the Salle des Croisades, in the Palace of Versailles.

Discovery of a Lost Statue by Canova.—It appears, by the *Journal de Frankfort*, that a statue of Napoleon the First, by Canova, which stood in the Salle des Etats in the time of Jerome, king of Westphalia, has been found hidden in a barn in the garrison of Cassel. Unfortunately, at the time of the retreat from Moscow, the statue was removed and mutilated, the arms, it is said, having been sawn off. The French consul has applied to the Prussian authorities for the statue in question.

Manufactures.

Havre Maritime International Exhibition.—Mr. P. L. Simmonds is officially charged with the duty of visiting the principal seaport towns of the United Kingdom to afford information to intending exhibitors at this interesting gathering, which is to open in June. The various ship and boat builders, engineers, sailmakers, provision dealers, outfitters, and coal agents, are likely to be well represented.

Quicksilver Mines in Italy.—In Tuscany there are four mines of quicksilver, but at the present time three have been abandoned on account of the low price now obtained for this metal. The only mine now worked is that of Siele, near Castelazara. The quantity of ore extracted in 1864, was 3,000 quintals (300 tons), which yielded from 2 to 2½ per-cent. of quicksilver—about 6,000 kils. Quicksilver is also found in the neighbourhood of Agordo, in the Venetian provinces. The veins of sulphide of mercury are said to be most extensive, but are worked on a very small scale. The following is the annual produce of quicksilver in Italy:—

Mines.	Quintals.	Value.
Castelazara	3,000	3,600 francs.
Agordo	44,608	53,000 „
Smelting Works.		
Castelazara	66	34,200 „
Agordo	230	91,840 „

From 1863 to 1865 the imports of quicksilver were 10,900 kils., of the value of 71,100 francs; and the exports 1,000 kils., of the value of 2,700 francs.

Science and Industry in Russia.—The Russian Society of Acclimatisation announces a second exhibition for the encouragement of agriculture, to open at Moscow on the 27th of July, and to close on the 16th of August in the present year. The Society offers a considerable number of gold, silver, and bronze medals. The Council of the University of Moscow has determined on the creation of an industrial museum, to be opened gratis on Sundays. The Professors of the University propose also to establish courses of lectures on the applications of science to industry, and on the apparatus and implements to be found in the new museum. The Agronomic Society of Moscow has now under discussion the formation of an agricultural museum. The Russian Geographic Society continues to exhibit much activity. At one of its recent meetings Mr. Lerch gave a detailed account of his recent visit to Central Asia, and especially concerning the ruins of Djankend and Sauran, and Mr. Prioroff presented drawings which he had made of remarkable objects found in the ruins of Djankend. An account was also read of the Witim expedition, undertaken for the discovery of a practical route between Nertschinsk and the goldfields of the basin of the Léna; besides the chief results in view, the commission is occupied with geological observations, and has also sent home a rich collection of plants and birds. The commission, under Mr. Daniloff, appointed to visit the northern coasts of the Sea of Azoff, and to study the formation of the sand banks, and the effect of water on the higher banks, has completed its work. The Society has established branches at Vilna and Orenbourg. The port of Odessa was free of ice on the 5th of February, and the arrival of three steamers ordered by the Society of Commerce and Navigation for the transport of the anthracite extracted from the mines of the Don, was expected. The following is the official account of the quantities of gold furnished by the Government of Jenissëisk during the years 1861 to 1866 inclusive, and of the number of workmen engaged in the workings:—

	Gold pouds.[*]	Workmen.
1861	605	16,375
1862	559	18,640
1863	557	14,370
1864	499	15,995
1865	487	13,800
1866	482	13,900

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[*] A poud is rather more than 36 lbs. English.

Commerce.

Wine Growing in France.—According to the most recent official returns, the area of land devoted to the cultivation of the vine in France, is 5,384,600 acres. In 1840 the total acreage under cultivation of vines was 4,870,840 acres; in 1850, 5,387,070 acres. The diminution since 1850 must, to a certain extent, be attributed to the disease amongst the vines. The average annual produce of wine in France at the present time amounts to upwards of 1,100 millions of imperial gallons.

Mines in France.—There are computed to be 1,184 mines in France of all kinds, of which 598 are coal, 249 iron, and 337 of other minerals. The total value of coal and iron raised last year amounted to 472,000,000 francs.

Improvement in Telegraphic Despatches.—Within the last few days the French telegraphic administration has introduced an ingenious check against accidents or intentional alterations in telegraphic despatches, on Hughes' system. Heretofore the strip containing the message was merely gummed on to a half-sheet of paper in which it was despatched, and might with little trouble be detached and changed. To prevent this, the despatch, after being attached to the paper, is passed between a pair of watering rollers, so that any displacement will be shown by the interference with the lines of the pattern; and, in addition to this, the words "Empire Français, Ministère de l'Interieur, Administration des Lignes Télégraphiques" run across the surface of the despatch, and form an additional guarantee.

Exports of Grain from Italy.—In 1867 the exports of grain from Italy to France amounted to 457,000 quintals of wheat, 5,000 quintals of maize, 8,000 quintals of barley, and 195,000 quintals of oats. In previous years the average exports to France did not amount to more than 50,000 quintals. Judging from the exports that have been made during the first two months of the present year, it may be fairly anticipated that the exports in 1868 will be even greater than that of 1867.

Commerce in France.—The administration of the Douane has recently issued a comparative statement of imports and exports of the special commerce of France, that is to say, exclusive of foreign articles imported, and re-exported, for the past seven years, namely, from 1861 to 1867, both inclusive. The total of the imports and exports together has increased within that period from £174,720,000 to £245,120,000, but the exports have not kept pace with imports, as the following table shows:—

	Imports. Frs.	Exports. Frs.
1861	2,442,000,000	1,926,000,000
1862	2,199,000,000	2,243,000,000
1863	2,426,000,000	2,643,000,000
1864	2,528,000,000	2,924,000,000
1865	2,642,000,000	3,088,000,000
1866	2,793,000,000	3,181,000,000
1867	3,156,000,000	2,972,000,000

So that while the imports have steadily increased every year since 1862, the exports have remained nearly stationary for four years, and exhibit a deficit in 1867 as compared with either of the two preceding years. This latter falling off is attributable to bad harvests, which caused grain to be imported instead of being exported; thus the exports of 1867 include 796 millions of francs against 500 millions in 1866 for the principal items of food, the increase being made up of 206 millions for wheat and flour, 46 millions for cattle and other animals, 5 millions for meat, and 27 millions for butter, cheese, and other articles. The imports of materials for manufacture, on the other hand, only exhibit an increase of 32 millions of francs, in a total of very nearly 200 millions; thus, while there was an increase in raw hides, wool, silk, flax, manures, and forage, there was a falling off in cotton, to the extent of 85 millions of francs, and also in coal and petroleum. In the exports of manufactured articles we find a diminution,—in silk tissues, 48 millions, woollen tissues, 18 millions, cottons, 12 millions, and refined sugar, 2 millions of francs; and augmentations—in furniture, 6 millions, objects of virtù, 12 millions, articles de Paris (fancy articles), 5 millions of francs. In the exports of raw material and food the same year (1867) exhibited a falling off in grain and flour to the extent of 122 millions, wine, 43 millions, spirits, 9 millions, cattle, 22 millions, and mules, 5 millions of francs; and an increase in fruit for dessert, to the extent of 4 millions, oilcake, 2 millions, wool, 17 millions, silk 5 millions, and cotton, 3 millions of francs.

Coal Mining in Italy.—A company has just been formed at Naples for coal mining in the Neapolitan provinces, and in consequence of experiments that have been made at the naval arsenal, the government has ordered 50 tons, which are to be supplied from the mines of Giffoni, Valle Piana, in the Principato Citeriore. The experiments that have been made with this coal at Naples prove that it is of excellent quality, and most suitable for gas manufacture.

Colonies.

Colonial Wool.—The following is a statement of the imports of colonial wool into Great Britain during 1867, compared with those of the previous year:—

	1867.	1866.
New South Wales and Queensland	101,695	82,184
South Australia	44,961	40,510
Victoria	170,444	141,931
Western Australia	3,596	3,565
Tasmania	15,943	16,422
New Zealand	76,729	64,243
Cape of Good Hope	128,287	106,794
Total	541,655	455,649

Showing an increase of 86,006 bales, of about 400lbs. each, over the imports of last year.

In the Melbourne Savings Bank the deposits, during the year ending with June last, were smaller than during any of the preceding nine years. From the decennial statement it appears that prior to 1865 the amounts deposited increased steadily, year by year, from £362,678 in 1858, to £480,332 in 1864, but 1865 witnessed an enormous falling off, and a still further decline took place in each of the subsequent years. The amount of deposits received was:—

In 1864	£480,392	In 1866	£353,679
1865	419,934	1867	348,554

Labour in Queensland.—The cotton and sugar planters of this colony are exerting themselves to introduce South Sea Islanders into the colony, as there is a feeling that the introduction will be very beneficial. The labour of the coloured race is preferred to that of the white men, because of its cheapness, and the ability of the Polynesians to work in the open air in summer without difficulty. There are many people who object to this proposal, and they have presented a petition to the Governor; meanwhile a Bill has been passed by the Legislative Assembly for regulating the introduction and employment of the South Sea Islanders.

The Imports into Western Australia for the year ended 30th September, 1867, were £216,299, against £202,338 for the previous year; and the exports were £167,819 against £157,137 for the previous year, the present returns showing an increase in both cases. The principal exports were wool, £90,965; sandal wood, £22,090; horses (380), £8,360; flour, £5,190; lead ore, £10,824; copper ore, £4,155; timber, £4,537; whale oil, £1,542; provisions, £3,371.

Publications Issued.

Recollections of the Paris Exhibition of 1867, by Eugene Rimmel. *(Chapman and Hall.)* The work is what its title professes it to be, a description of the plan and leading objects of the exhibition. It appears that the author undertook to write a description of the exhibition for two newspapers, the *Courrier de l'Europe* and *La Patrie.* In this work he was assisted by several of the French and Foreign Commissioners, as well as by some of the exhibitors, and the articles were published at Paris in the form of a book, entitled "Souvenirs de l'Exposition," with numerous engravings, principally borrowed from the "Illustrated Catalogue" issued by Mr. S. C. Hall in connection with the *Art Journal.* The present work is an English version of the foregoing.

Notes.

Primary Instruction in France.—Heretofore general education has been left almost entirely in the hands of the Government in France, but it is now admitted that with all the good-will in the world a Minister of Education cannot do everything at once; the cost stands in the way on one hand, while routine raises all kinds of obstacles in the road. Much has been done, but there still remain 650 communes without schools for primary instruction; and a great friend of education, the Comte de Madre, has just published a work entitled "Moyen de Créer et d'Entretenir des Ecoles, Spécialement par Voie d'Association," containing not only a collection of documentary matter, but suggestions as to the best method of bringing individual efforts and association to bear effectively on the subject. M. de Madre looks upon association as preferable to individual efforts, the latter having frequently too much the air of personal patronage. It may be mentioned that efforts of the kind recommended by the author have been made with success in one instance at Bellevue, near Saint Cloud. M. de Madre gives a curious illustration of the working of the common school system, and of the operation of short-sighted or purely selfish ignorance in France; he says, that in many communes the schools are frequented especially by the children of the poor, while those of small farmers or graziers are kept at home to watch the cattle in order to save a few centimes a day to their parents. The effect of this, says the author, will be the reversal of their social position, for in the next generation the employer's children will be inferior to those of the labourer; a hint for improvident or selfish parents, which certainly is worth recording.

New Organ at Notre Dame.—The old organ of Notre Dame, which was constructed in the time of Louis XV., by Thierry Lescope, one of the most famous constructors of that time, was repaired and improved at the end of the last century by the celebrated organ builder Clicquot; between 1832 and 1838 the organ was again repaired by the makers Dalery; and, lastly, in 1863, the government commissioned Messrs. Cavaillé-Coll to restore the organ completely, and introduce all the most modern improvements. The work is just finished, and the result is highly spoken of. The new organ has 110 registers, distributed over five key-boards for the hands, and one for the feet. It has twenty-two compound pedals, and about 6,000 pipes, of which the longest is said to be 32 feet long. The instrument embraces about ten octaves, that is to say, the entire range of appreciable tones. The movements are transmitted by means of pneumatic arrangements, similar to those applied to the organ of Saint Sulpice. The bellows, or rather the air chamber, contains 25,000 litres, or about 5,500 gallons of air, and is supplied by six pairs of pumps, giving 600 litres of air per second.

Paris Universal Exhibition.—The Imperial Commission has just issued a notice to the subscribers to the guarantee fund, informing them that the advances made are now receivable, with the addition of 5 per cent. calculated from the 20th of July, 1865 (when the guarantee list was opened) to the 20th of the present month. The Commission adds, that all the materials in the Champ de Mars have now been sold, and that, in a short time, the guarantors will be informed of the amount due to them in the way of profit.

Annual Cattle Show in France.—The annual show of cattle and animals, which has taken place at Poissy without interruption since 1844, is to be held this year at the new Cattle Market, at La Villette, Paris. The Minister of Agriculture has issued the programme of the show. The animals are to be received and weighed on the 4th and 5th of April; on the following day the jury makes its awards, the public being admitted in the afternoon by payment of five francs each person; on Tuesday, the 7th of April, the admission will be one franc; and on the following day the exhibition will be thrown open gratis. The prizes, which will be distributed by the Minister of Agriculture, amount to 160 in number, and to more than £3,200 in value; besides medals of gold, silver, and bronze, for the three classes of rewards, the money prizes amount to 67,250 francs for horned cattle, 9,150 francs for sheep, and 5,050 francs for pigs. In addition to these a Cup of Honour wil be given in each section, of the respective value of 3,000, 1,500, and 800 francs. A very fine show is anticipated.

MEETINGS FOR THE ENSUING WEEK.

Mon......R. Geographical, 8½. "A Journey to Lhasa and the Source of the Brahmaputra by a Pundit, under the direction of Capt. T. G. Montgomerie, R.E."
Social Science Assoc., 8. Mr. G. W. Hastings, "On the further Amendment of the Law of Evidence in Civil Cases."
Tues ...Civil Engineers, 8. Continued discussion upon Mr. Sandberg's paper, "On the Manufacture and Wear of Rails."
Ethnological, 8.
Royal Inst., 3. Dr. M. Foster, "On the Development of Animals."
Wed ...Society of Arts, 8. Mr. A. S. Bicknell, "On Horse as an Article of Food."
Geological, 8. 1. Mr. Henry Woodward, "On some New Forms of Palæozoic Corals." 2. Prof. Harkness and Mr. H. A. Nicholson, "On the Coniston Group." 3. Dr. A. Leith Adams, "Death of Fishes on the Coast of the Bay of Fundy."
Archæological Assoc., 8½.
Thur ...Royal, 8½.
Antiquaries, 8½.
Zoological, 8½.
Philosophical Club, 6.
Mathematical, 8.
Royal Inst., 3. Dr. M. Foster, "On the Development of Animals."
Society of Fine Arts, 8. Mr. T. R. S. Temple, "On the Modern French Drama."
Fri.......Society of Arts, 8. Cantor Lectures. Dr. F. Crace Calvert, F.R.S., "On Chloride of Sodium."
Royal Inst., 8. Dr. Carpenter, "On the Unconscious Action of the Brain."
R. United Service Inst., 3. Major S. Bevan Edwards, R.E., "An Organisation for the Army of England."
Sat ......Royal Inst., 8. Professor Roscoe, "On the Non-Metallic Elements."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. Numb. *Delivered on 7th March*, 1868.

113. Irish Reproductive Loan Fund—Account.
River Plate, No. 1 (1868)—Correspondence.
Foreign Office Agencies—Statement.
Foreign Office Agencies—Names, &c.
Education—Revised Code.
Public General Acts—Cap. 7.
Public Petitions—Fifth Report.

Delivered on 9th March, 1868.

48. Bill—Fairs (Ireland).
120. Piers and Harbours—Report of the Board of Trade.

121. Malt and Barley—Returns.
122. Malt and Barley—Return.
124. Consolidated Fund—Abstract Accounts.
125. Abyssinia—Letter.
126. Committee of Selection—First Report.

Delivered on 10th March, 1868.

74. Navy—Estimates (1868-69).
75. Greenwich Hospital—Estimate.
81. Revenue Departments—Accounts.
Mexico—Papers relative to the Withdrawal of the British Mission.
Boundary Commission—Report of the Commissioners.

Delivered on 11th March, 1868.

52. Bill—County Financial Boards (No. 2).
67. Civil Services—Returns.
82. Works and Public Buildings—Abstract Accounts.
83. Woods, Forests, and Land Revenues—Abstract Accounts.
85. Naval Receipt and Expenditure—Appropriation Accounts.
87. Army and Militia Services—Appropriation Accounts.
131. Prison Dietaries (Ireland)—Return.
Public Petitions—Sixth Report.

Delivered on 12th March, 1868.

53. Bill—Railway and Joint Stock Companies' Accounts.
26. Navy (Designs for Ships)—Circular Letter.
84. Navy—Statement.
105. East India (Revenues)—Return.
106. East India (Loan)—Return.
130. Railway and Canal Bills—First Report.
136. (I. to V.) Railway, &c., Bills—Board of Trade Reports.
Heligoland and Hong Kong—Agreement, &c.
Portugal—Correspondence respecting Commercial Relations (1866-8).

Delivered on 13th March, 1868.

49. Bill—Metropolis Gas.
54. „ Oyster and Mussel Fisheries.
59. „ Compulsory Church Rates Abolition (amended).
112. Supply—Return.
The "Tornado" (No. 1, 1868)—Correspondence.
Railways—Report by Colonel Yolland on Electrical Communication.

Delivered on 14th March, 1868.

96. Storm Warnings—Letter.
134. Farnham Union—Report of Mr. Lambert.
138. Duchy of Cornwall—Account.
139. Civil Services—Supplementary Estimate.
Public Petitions—Seventh Report.

Delivered on 16th March, 1868.

127. Spirits, &c.—Return.
Coal (British Colonies, &c.)—Reports from Her Majesty's Secretaries of Embassy and Legation.

Patents.

From Commissioners of Patents' Journal, March 13.

GRANTS OF PROVISIONAL PROTECTION.

Advertisements, exhibiting—631—O. Ollivier.
Anchors—703—W. J. Armstrong and C. Browne.
Axles, &c., bearings for—642—T. Hill.
Bedsteads for military purposes—564—J. M. Kilner.
Blinds, raising and lowering venetian—660—L. Boyce.
Boats, &c., building—664—W. E. Newton.
Boilers—657—T. Blocksage.
Boilers—679—J. Robinson.
Boilers, feeding—634—G. T. Bousfield.
Boots and shoes, heels for—632—J. L. Jaquet.
Bottles, feeding—646—J. Perrett.
Bottle stoppers—663—J. Adams and H. Barrett.
Bottle stoppers—669—G. Eldridge and W. C. Loe.
Bottles, &c., caps or covers for—675—A. S. Stocker.
Bridges—548—E. W. Young.
Cans or vessels to contain liquids—667—J. H. Bass.
Carriages and chairs, folding—684—T. Trotman.
Chlorine, &c., manufacture of—662—W. Weldon.
Composition, non-conducting—619—F. Le Roy.
Drilling machines—622—E. Hutchinson.
Fabrics, finishing—685—W. E. Newton.
Fabrics, finishing woven—661—J. B. Whiteley.
Fabrics, preparing for dyeing—659—R. E. Green.
Fabrics, washing, &c.—672—R. Mills.
Fire-arms, breech-loading—655—J. R. Cooper.
Fuel for household purposes—259—J. Mason.
Furnaces—579—C. Cochrane.
Glass furnaces—682—T. Warren.
Glass, &c., moulds for moulding—677—C. E. Brooman.
Iron and steel, manufacturing—686—C. Sanderson.
Iron and steel, manufacturing—688—J. Gjers.
Iron, &c., decarbonization of molten—462—H. T. Humphreys.
Jute, &c., preparing—683—J. F. Low.
Liquids, &c., pumping and measuring—643—R. Laidlaw and J. Thomson.
Looms—626—J. J. and E. Harrison.
Lubricators—620—J. Elce.
Luggage labels—697—A. H. Hill.
Millstones, dressing—707—J. Rawsthorn.
Motive-power—695—G. Lindsley.
Muffs—627—J. C. Davies and E. Zahn.
Nails, &c.—561—M. Henry.
Oils, purifying hydrocarbon—648—F. Lambe, A. C. Sterry, and J. Fordred.
Paper fabrics, &c., rendering waterproof—440—N. C. Szerelmey.
Paraffine, treating—610—J. Fordred, F. Lambe, and A. C. Sterry.
Paving—678—J. Leacock.
Piles, constructing—711—S. Sharrock.
Printed surfaces, &c., laying metal leaves on—68—L. Simon.
Printing machines, lithographic—671—J. Christie.
Railway fastenings, steel spring—418—A. B. Ibbotson.
Railway trains, signals for—538—A. M. Keighley.
Respirators—713—A. A. Usher.
Sea, preventing collisions at—608—J. S. Gisborne.
Sewing machines—681—G. Thomas.
Ships' bottoms, preventing the fouling of 668—W. M. Bullivant.
Signal indicators for mining and other purposes—638—R. Ramsey and J. Cooke.
Spinning and twisting machinery—652—R. and J. W. Gaunt.
Taps—676—R. Howard.
Telescopes—701—B. Solomons.
Tuyeres, hot blast water—689—C. Coohrane.
Umbrellas and parasols—606—A. Stenger.
Valves for pipes, flues, &c.—715—C. Cochrane.
Washing machines—650—W. E. Newton.
Weighing apparatus, portable—474—J. Thornton and W. F. Voss.
Wells, sinking—699—J. L. Norton.
Window sash fastenings—687—T. S. Whilock and H. Harford.
Wire, coated—624—G. W. R. Pigott.

INVENTION WITH COMPLETE SPECIFICATION FILED.

Fibrous materials, treating—818—W. R. Lake.

PATENTS SEALED.

2599. W. G. Brownson.
2606. G. Pickin.
2610. W. J. Cunningham.
2613. W. Brailsford & J. Gadsby.
2615. T. Turner.
2645. F. T. M. A. Guyon.
2811. N. F. Taylor.

From Commissioners of Patents' Journal, March 17.

PATENTS SEALED.

2625. T. Adams and G. J. Parson.
2632. J. Rust.
2636. T. Bletcher.
2639. J. H. Sams.
2640. W. W. Gibson.
2649. R. Raffault.
2650. S. Dreyfous.
2652. W. Hall.
2664. J. Baird.
2667. T. Muir.
2669. J. Rives.
2673. G. W. MacGeorge.
2674. C. Ritchie.
2698. J. Musgrave.
2699. A. Tod and J. Heatley, jun.
2791. S. Johnson.
2817. R. P. Faucheux.
2837. J. H. Johnson.
2867. H. B. Barlow.
2887. W. R. Lake.
2898. B. Latham.
2971. A. V. Newton.
2991. H. Adcock.
3381. E. H. Bentall.
19. E. J. and W. A. Krüss.
69. S. Goldstein.
76. J. Dawson and J. Howorth.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

779. W. Menelaus.
671. E. A. Phillips.
693. J. M. Napier.
697. R. M. Roberts.
2921. H. C. Davis.
695. J. Tann.
701. R. Marsden.
712. R. A. Brooman.
722. N. N. Solly.
736. J. Ramsbottom.
893. W. M. Fuller.
913. A. V. Newton.
914. A. V. Newton.
765. J. C. Stevenson.
730. J. F. Brinjes.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

637. E. T. Truman.
638. E. A. Pontifex.
753. J. Chatterton & W. Smith.
506. J. Taylor, jun.

Registered Designs.

4929—Feb. 13th—An improved collar—J. Jowett, 48, Conduit-street, Regent-street, W.
4930—Feb. 20th—A brace or band buckle—J. Stokes, New-street, Walsall.
4931—Feb. 22nd—Shape or configuration of a surgical sole, for use in cases of malformation—W. H. Spratt, 14, Brook-street, Hanover-square, W.
4932—Feb. 24th—A blind pulley—Cope and Collinson, Sumner-row, Birmingham.
4933—March 2nd—Improved universal saw iron—W. Wright, Albion-street, Birmingham.
4934—March 5th—Lock plate shutter fastening—J. G. Stidder, 15, Hanover-street, Long-acre, W.C.
4935—March 6th—An improved metallic neck tie fastening—J. Hill, Harford-street, Birmingham.
4936—March 6th—A holder for gas lights and lamp shades and reflectors—L. Leoni, 34, St. Paul's-street, N.
4937—March 14th—Call bell—W. Tonks and Sons, Birmingham.
4938—March 18th—A fastening—E. Holt, Willenhall, Stafford.